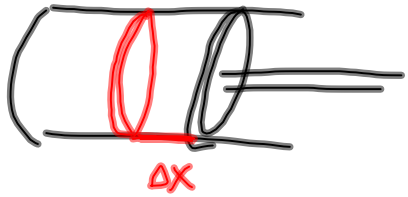
12



$W = \int_a^b F\,dx = \int_{V_1}^{V_2} P\,\Delta A\,dx$

$P = \frac{F}{\Delta A} \qquad F = P\Delta A$

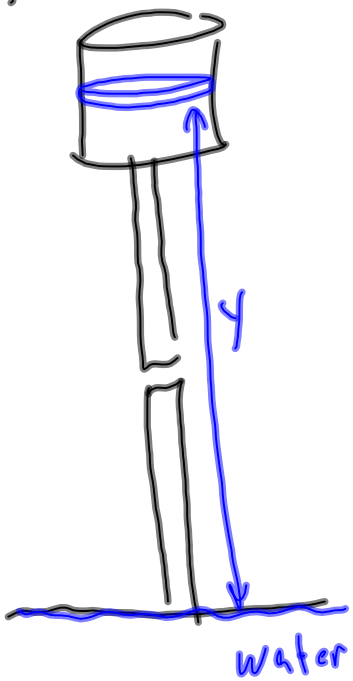
a) $W = \int_{(P_1,V_1)}^{(P_2,V_2)} P\,dV = \int_{243}^{32} \frac{109{,}350}{V^{1.4}}\,dV$

b) $P_1 = 50$ lb $\qquad PV^{1.4} = \text{constant} \qquad P_2 = ?$

$V_1 = 243 \qquad 50 \cdot 243^{1.4} = 109{,}350 \qquad V_2 = 32$

Jan 9-9:18 AM

24.



$\Delta W = \Delta F \cdot y$

$= \Delta V \cdot 62.4\ y$

$= \pi r^2 \Delta y\ 62.4\ y$

$= \pi \cdot 10^2\ 62.4\ y\ \Delta y$

$W = \int_{360}^{385} \pi \cdot 10^2\ 62.4\ y\,dy$

Tank $= 182{,}537{,}949.1$ ft·lbs

Pipe:

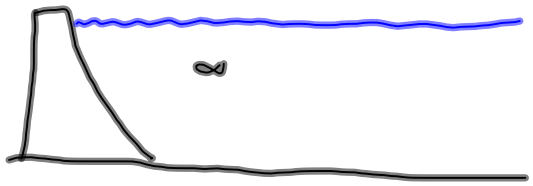
Jan 9-9:17 AM

7.5b Applications of Integrals

Fluid pressure

Why are dams thicker at the bottom? water pressure is greater at the bottom

Does the fluid pressure at any point on a dam depend on the amount of water held back by the dam? No



$p = \frac{F}{A}$

$p = w \cdot h$

p = pressure

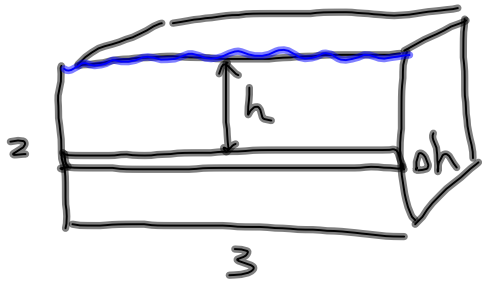
w = weight density

h = depth

$F = p \cdot A$ (constant pressure)

Dec 17-7:34 PM

What is the total force on the front side of an aquarium if the side is 3ft wide by 2ft tall? $p = w \cdot h$



$\Delta F = p\,\Delta A$

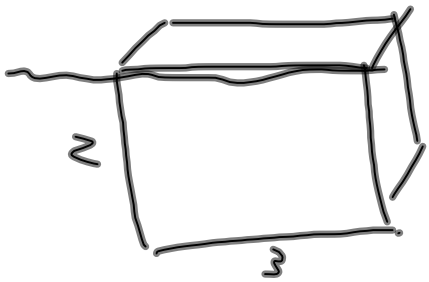
$= w h\,\Delta A$

$= 62.4\,h\,\Delta A$

$\Delta F = 62.4\,h\,3\,\Delta h$

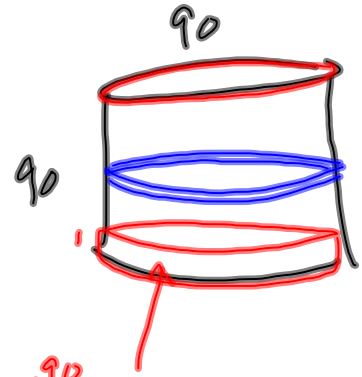
$F = \int_0^2 62.4\,h\,3\,dh$

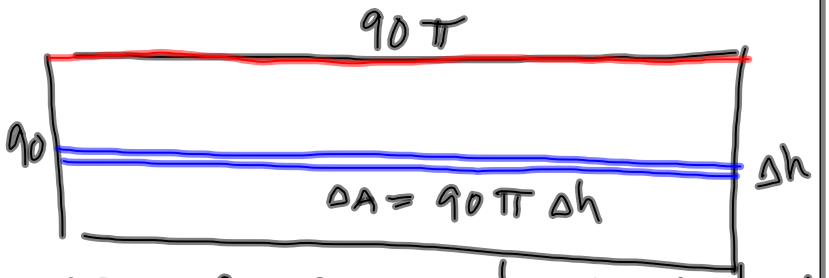
$F = 374.4$ lbs



Dec 17-7:38 PM

The Puritan Distilling Company had a 90 ft high, 90 ft diameter cylindrical metal tank filled with molasses which weighs 100 lb/ft^3. In 1919 the tank exploded due to fluid pressure. What was the total fluid force on the tank wall?





$\Delta F = \rho\, \Delta A = wh\, \Delta A = 100h\, \Delta A$

$\Delta F = 100h\, 90\pi\, \Delta h$

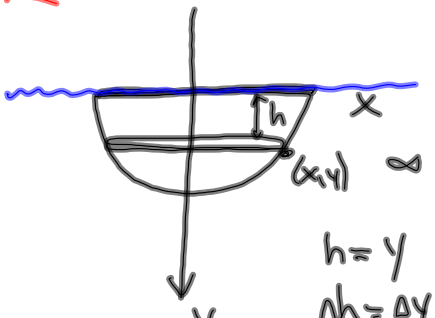
$\int_{89}^{90} 100h\, 90\pi\, dh$

$2{,}500{,}000$ lbs

$F = \int_0^{90} 100h\, 90\pi\, dh = 114{,}511{,}052$ lbs

Dec 17-7:39 PM

A steel plate in the shape of a semicircle is submerged vertically in sea water. Find the fluid force on the plate if it has a 4 ft diameter.



$h = y$

$\Delta h = \Delta y$

$x^2 + y^2 = 2^2$

$x = \sqrt{4 - y^2}$

$\Delta F = \rho\, \Delta A = wh\, \Delta A$

$= 64h\, \Delta A$

$= 64h\, 2x\, \Delta h$

$= 64y\, 2x\, \Delta y$

$\Delta F = 64y\, 2\sqrt{4-y^2}\, \Delta y$

$F = \int_0^2 64y\, 2\sqrt{4-y^2}\, dy$

$= 341.333$ lbs

Dec 17-7:45 PM